The listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

Claims 1-10 (Canceled)

Claim 11 (Currently Amended): A method of estimating, from data obtained by exploration of a zone of a heterogeneous medium, a model representative of a distribution, in the zone, of at least one physical quantity, the model being free of a presence of correlated noises that may be contained in the data, comprising:

a)   acquiring measurements giving information about physical characteristics of the zone by following a predetermined experimental protocol;

b)   specifying a noise modelling operator which associates, with a model of each physical quantity, synthetic data that constitute a response of the model, the measurements and the synthetic data belonging to a data space;

c)   selecting, for each correlated noise referenced by a subscript j ranging from 1 to J, a noise modelling operator which associates a correlated noise with a noise-generating function belonging to a predetermined spaced of the noise-generating functions (B_j);

d)   specifying a norm or of a semi-norm in the data space;

e)   specifying a semi-norm in the space of the noise-generating functions

for which each noise modelling operator establishes substantially an isometric

relation between the space of noise-generating functions and the data space;

f)   defining a cost function quantifying a difference between the

measurements on one hand and a superposition of a model response and of the

correlated noise associated with the noise-generating function on the other hand;

and

g)   ~~adjustment of~~ adjusting the model and of the noise-generating

functions by minimizing the cost function, by means of an algorithmic method taking

advantage of isometry of properties of the noise modelling operators.

Claim 12 (Previously Presented): A method as claimed in claim 11,

wherein:

a distribution as a function of depth of an acoustic impedance in the medium

is sought, the correlated noises affecting the data are tube waves each identified by

parameters characterizing their propagation, the measured data are VSP data

obtained by means of pickups which detect displacement of particles in the medium

in response to a localized seismic excitation, the location of the pickups and a

recording time and time sampling points being defined, and the selected noise

modelling operator associates the synthetic data with an acoustic impedance

distribution as a function of an evaluated depth in travel time and with vertical stress

measured as a function of time at a depth of the first pickup.

Claim 13 (Previously Presented): A method as claimed in claim 12, wherein:

the cost function quantifying the difference is a square of the semi-norm of the difference in the data space.

Claim 14 (Previously Presented): A method as claimed in claim 12, wherein:

adjustment of the model and of the noise-generating functions is obtained by means of a block relaxation method for eliminating unknowns corresponding to each correlated noise generating function, the block relaxation method being implemented within iterations of a quasi-Newtonian algorithm for calculation of the model.

Claim 15 (Previously Presented): A method as claimed in claim 13, wherein:

adjustment of the model and of the noise-generating functions is obtained by means of a block relaxation method for eliminating the unknowns corresponding to each correlated noise generating function, this the block relaxation method being implemented within the iterations of a quasi-Newtonian algorithm for calculation of the model.

Claim 16 (Previously Presented): A method as claimed in claim 12, wherein:

numerical calculation of the image of a model by the modelling operator is carried out by a numerical solution of a 1D wave equation for the model, by selecting values taken by displacement of the particles at locations of pickups and at previously defined time sampling points, and by applying an operator likely to compensate for spherical divergence and attenuation effects.

Claim 17 (Previously Presented): A method as claimed in claim 13, wherein:

numerical calculation of the image of a model by the modelling operator is carried out by a numerical solution of the a 1D waves equation for the model considered, by selecting values taken by the displacement of the particles at the locations of pickups and at the previously defined time sampling points, and by applying an operator likely to compensate for the spherical divergence and attenuation effects.

Claim 18 (Previously Presented): A method as claimed in claim 14, wherein:

numerical calculation of the image of a model by the modelling operator is carried out by a numerical solution of the a 1D waves equation for the model considered, by selecting values taken by the displacement of the particles at the locations of pickups and at the previously defined time sampling points, and by

applying an operator likely to compensate for the spherical divergence and attenuation effects.

Claim 19 (Previously Presented): A method as claimed in claim 15, wherein:

numerical calculation of the image of a model by the modelling operator is carried out by a numerical solution of the a 1D waves equation for the model considered, by selecting values taken by the displacement of the particles at the locations of pickups and at the previously defined time sampling points, and by applying an operator likely to compensate for the spherical divergence and attenuation effects.

Claim 20 (Previously Presented): A method as claimed in claim 12, wherein:

the noise modelling operator is a finite-difference centered numerical scheme for discretizing a noise transport equation, and a utilized noise generating function has an initial condition along an edge of an observation zone belonging to the space (B_j): of support time functions in a give time interval.

Claim 21 (Previously Presented): A method as claimed in claim 13, wherein:

the noise modelling operator is a finite-difference centered numerical scheme for discretizing the a noise transport equation, and the a utilized noise-generating function involved as the function has an initial condition along the an edge of the an

observation zone belongs belonging to a the space (B_j) consisting of the support

time functions in a give time interval.

Claim 22 (Previously Presented): A method as claimed in claim 14, wherein:

the noise modelling operator is a finite-difference centered numerical scheme for discretizing the a noise transport equation, and the a utilized noise-generating function involved as the function has an initial condition along the an edge of the an observation zone belongs belonging to a the space (B_j) consisting of the support time functions in a give time interval.

Claim 23 (Previously Presented): A method as claimed in claim 15, wherein:

the noise modelling operator is a finite-difference centered numerical scheme for discretizing the a noise transport equation, and the a utilized noise-generating function involved as the function has an initial condition along the an edge of the an observation zone belongs belonging to a the space (B_j) consisting of the support time functions in a give time interval.

Claim 24 (Previously Presented): A method as claimed in claim 16, wherein:

the noise modelling operator is a finite-difference centered numerical scheme for discretizing the a noise transport equation, and the a utilized noise-generating function involved as the function has an initial condition along the an edge of the an

12

observation zone belongs belonging to a the space (B_j) consisting of the support time functions in a give time interval.

Claim 25 (Previously Presented): A method as claimed in claim 17, wherein:

the noise modelling operator is a finite-difference centered numerical scheme for discretizing the a noise transport equation, and the a utilized noise-generating function involved as the function has an initial condition along the an edge of the an observation zone belongs belonging to a the space (B_j) consisting of the support time functions in a give time interval.

Claim 26 (Previously Presented): A method as claimed in claim 18, wherein:

the noise modelling operator is a finite-difference centered numerical scheme for discretizing the a noise transport equation, and the a utilized noise-generating function involved as the function has an initial condition along the an edge of the an observation zone belongs belonging to a the space (B_j) consisting of the support time functions in a give time interval.

Claim 27 (Previously Presented): A method as claimed in claim 19, wherein:

the noise modelling operator is a finite-difference centered numerical scheme for discretizing the a noise transport equation, and the a utilized noise-generating function involved as the function has an initial condition along the an edge of the an

13

observation zone belongs belonging to a the space (B$_j$) consisting of the support

time functions in a give time interval.

Claim 28 (Previously Presented): A method as claimed in claim 12, wherein:

a semi-norm selected for the data space is:

$$\|u\|_{\mathcal{D}} = \left(\Delta x\, \Delta t \sum_{i=0}^{I-1} \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(u_i^{n+1} + u_i^n \right)^2 \right)^{\frac{1}{2}}$$

and a semi-norm selected for the space of the noise-generating function is:

$$\|\beta\|_B = \left(\Delta x\, \Delta t\, I \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(\beta^{n+1} + \beta^n \right)^2 \right)^{\frac{1}{2}}$$

Claim 29 (Previously Presented): A method as claimed in claim 13, wherein:

the a semi-norm selected for the data space is:

$$\|u\|_{\mathcal{D}} = \left(\Delta x\, \Delta t \sum_{i=0}^{I-1} \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(u_i^{n+1} + u_i^n \right)^2 \right)^{\frac{1}{2}}$$

14

and the a semi-norm selected for the space of the noise-generating function space is:

$$\|\beta\|_B = \left(\Delta x\, \Delta t\, I \sum_{n=0}^{N-1} \frac{1}{T^{n+\frac{1}{2}}} \left(\beta^{n+1} + \beta^n\right)^2 \right)^{\frac{1}{2}}$$

Claim 30 (Previously Presented): A method as claimed in claim 14, wherein:

the a semi-norm selected for the data space is:

$$\|u\|_D = \left(\Delta x\, \Delta t \sum_{i=0}^{I-1} \sum_{n=0}^{N-1} \frac{1}{T^{n+\frac{1}{2}}} \left(u_i^{n+1} + u_i^n\right)^2 \right)^{\frac{1}{2}}$$

and the a semi-norm selected for the space of the noise-generating function space is:

$$\|\beta\|_B = \left(\Delta x\, \Delta t\, I \sum_{n=0}^{N-1} \frac{1}{T^{n+\frac{1}{2}}} \left(\beta^{n+1} + \beta^n\right)^2 \right)^{\frac{1}{2}}$$

Claim 31 (Previously Presented): A method as claimed in claim 15, wherein:

the a semi-norm selected for the data space is:

$$\|u\|_D = \left(\Delta x\, \Delta t \sum_{i=0}^{I-1} \sum_{n=0}^{N-1} \frac{1}{T^{n+\frac{1}{2}}} \left(u_i^{n+1} + u_i^n\right)^2 \right)^{\frac{1}{2}}$$

15

and the a semi-norm selected for the space of the noise-generating function space is:

$$\|\beta\|_B = \left(\Delta x \, \Delta t \, I \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(\beta^{n+1} + \beta^n\right)^2 \right)^{\frac{1}{2}}$$

Claim 32 (Previously Presented): A method as claimed in claim 16, wherein:

the a semi-norm selected for the data space is:

$$\|u\|_D = \left(\Delta x \, \Delta t \sum_{i=0}^{I-1} \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(u_i^{n+1} + u_i^n\right)^2 \right)^{\frac{1}{2}}$$

and the a semi-norm selected for the space of the noise-generating function space is:

$$\|\beta\|_B = \left(\Delta x \, \Delta t \, I \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(\beta^{n+1} + \beta^n\right)^2 \right)^{\frac{1}{2}}$$

Claim 33 (Previously Presented): A method as claimed in claim 17, wherein:

the a semi-norm selected for the data space is:

$$\|u\|_D = \left(\Delta x \, \Delta t \sum_{i=0}^{I-1} \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(u_i^{n+1} + u_i^n\right)^2 \right)^{\frac{1}{2}}$$

16

and the a semi-norm selected for the space of the noise-generating function space is:

$$\|\beta\|_B = \left(\Delta x \, \Delta t \, I \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(\beta^{n+1} + \beta^n\right)^2 \right)^{\frac{1}{2}}$$

Claim 34 (Previously Presented): A method as claimed in claim 18, wherein:

the a semi-norm selected for the data space is:

$$\|u\|_D = \left(\Delta x \, \Delta t \sum_{i=0}^{I-1} \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(u_i^{n+1} + u_i^n\right)^2 \right)^{\frac{1}{2}}$$

and the a semi-norm selected for the space of the noise-generating function space is:

$$\|\beta\|_B = \left(\Delta x \, \Delta t \, I \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(\beta^{n+1} + \beta^n\right)^2 \right)^{\frac{1}{2}}$$

Claim 35 (Previously Presented): A method as claimed in claim 19, wherein:

the a semi-norm selected for the data space is:

$$\|u\|_D = \left(\Delta x \, \Delta t \sum_{i=0}^{I-1} \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(u_i^{n+1} + u_i^n\right)^2 \right)^{\frac{1}{2}}$$

and the a semi-norm selected for the space of the noise-generating function space is:

$$\|\beta\|_B = \left(\Delta x \, \Delta t \, I \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(\beta^{n+1} + \beta^n \right)^2 \right)^{\frac{1}{2}}$$

Claim 36 (Previously Presented): A method as claimed in claim 20, wherein:

the a semi-norm selected for the data space is:

$$\|u\|_{\mathcal{D}} = \left(\Delta x \, \Delta t \sum_{i=0}^{I-1} \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(u_i^{n+1} + u_i^n \right)^2 \right)^{\frac{1}{2}}$$

and the a semi-norm selected for the space of the noise-generating function space is:

$$\|\beta\|_B = \left(\Delta x \, \Delta t \, I \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(\beta^{n+1} + \beta^n \right)^2 \right)^{\frac{1}{2}}$$

Claim 37 (Previously Presented): A method as claimed in claim 21, wherein:

the a semi-norm selected for the data space is:

$$\|u\|_{\mathcal{D}} = \left(\Delta x \, \Delta t \sum_{i=0}^{I-1} \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(u_i^{n+1} + u_i^n \right)^2 \right)^{\frac{1}{2}}$$

and the a semi-norm selected for the space of the noise-generating function space is:

$$\|\beta\|_B = \left(\Delta x \, \Delta t \, I \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(\beta^{n+1} + \beta^n \right)^2 \right)^{\frac{1}{2}}$$

Claim 38 (Previously Presented): A method as claimed in claim 22, wherein:

the a semi-norm selected for the data space is:

$$\|u\|_D = \left(\Delta x \, \Delta t \sum_{i=0}^{I-1} \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(u_i^{n+1} + u_i^n \right)^2 \right)^{\frac{1}{2}}$$

and the a semi-norm selected for the space of the noise-generating function space is:

$$\|\beta\|_B = \left(\Delta x \, \Delta t \, I \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(\beta^{n+1} + \beta^n \right)^2 \right)^{\frac{1}{2}}$$

Claim 39 (Previously Presented): A method as claimed in claim 23, wherein:

the a semi-norm selected for the data space is:

$$\|u\|_D = \left(\Delta x \, \Delta t \sum_{i=0}^{I-1} \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(u_i^{n+1} + u_i^n \right)^2 \right)^{\frac{1}{2}}$$

19

and the a semi-norm selected for the space of the noise-generating functions space is:

$$\|\beta\|_B = \left(\Delta x \, \Delta t \, I \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(\beta^{n+1} + \beta^n\right)^2 \right)^{\frac{1}{2}}$$

Claim 40 (Previously Presented): A method as claimed in claim 24, wherein:

the a semi-norm selected for the data space is:

$$\|u\|_{\mathcal{D}} = \left(\Delta x \, \Delta t \sum_{i=0}^{I-1} \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(u_i^{n+1} + u_i^n\right)^2 \right)^{\frac{1}{2}}$$

and the a semi-norm selected for the space of the noise-generating function space is:

$$\|\beta\|_B = \left(\Delta x \, \Delta t \, I \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(\beta^{n+1} + \beta^n\right)^2 \right)^{\frac{1}{2}}$$

Claim 41 (Previously Presented): A method as claimed in claim 25, wherein:

the a semi-norm selected for the data space is:

$$\|u\|_{\mathcal{D}} = \left(\Delta x \, \Delta t \sum_{i=0}^{I-1} \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(u_i^{n+1} + u_i^n\right)^2 \right)^{\frac{1}{2}}$$

20

and the a semi-norm selected for the space of the noise-generating function space is:

$$\|\beta\|_B = \left(\Delta x \, \Delta t \, I \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(\beta^{n+1} + \beta^n \right)^2 \right)^{\frac{1}{2}}$$

Claim 42 (Previously Presented): A method as claimed in claim 26, wherein:

the a semi-norm selected for the data space is:

$$\|u\|_D = \left(\Delta x \, \Delta t \sum_{i=0}^{I-1} \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(u_i^{n+1} + u_i^n \right)^2 \right)^{\frac{1}{2}}$$

and the a semi-norm selected for the space of the noise-generating function space is:

$$\|\beta\|_B = \left(\Delta x \, \Delta t \, I \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(\beta^{n+1} + \beta^n \right)^2 \right)^{\frac{1}{2}}$$

Claim 43 (Previously Presented): A method as claimed in claim 27, wherein:

the a semi-norm selected for the data space is:

$$\|u\|_D = \left(\Delta x \, \Delta t \sum_{i=0}^{I-1} \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(u_i^{n+1} + u_i^n \right)^2 \right)^{\frac{1}{2}}$$

21

and the a semi-norm selected for the space of the noise-generating function space is:

$$\|\beta\|_B = \left(\Delta x \, \Delta t \, I \sum_{n=0}^{N-1} \frac{1}{\tau^{n+\frac{1}{2}}} \left(\beta^{n+1} + \beta^n \right)^2 \right)^{\frac{1}{2}}$$

Claim 44 (Previously Presented): A method as claimed in claim 11, wherein:

a distribution of disturbances, in relation to a previously selected reference model, of an impedance and of a velocity in the zone of the medium is sought, the correlated noises affecting the data are due to multiple reflections whose kinematics and amplitude variations with an offset have been previously estimated, the measured data are picked up by seismic surface pickups, the location of the pickups, a seismic excitation mode, a recording time and time sampling points being defined, and the modelling operator being defined by linearization of the waves equation around the model representative of the distribution.

Claim 45 (Previously Presented): A method as claimed in claim 44, wherein:

the cost function quantifying the difference is the square of the semi-norm of the difference in the data space.

Claim 46 (Previously Presented): A method as claimed in claim 44, wherein:

adjustment of the model and of the noise-generating functions is obtained by a block relaxation method for eliminating unknowns corresponding to each correlated

noise generating function, the relaxation method being implemented within iterations of a conjugate gradient algorithm for calculation of the model.

Claim 47 (Previously Presented): A method as claimed in claim 45, wherein: adjustment of the model and of the noise-generating functions is obtained by means of a block relaxation method for eliminating the unknowns corresponding to each correlated noise generating function, this the relaxation method being implemented within the iterations of a conjugate gradient algorithm for calculation of the model.